

When standardized testing is not standardized.

Nalliah RP¹, Reddy M²

1 - Dr. Romesh P. Nalliah

Associate Dean for Patient Services, University of Michigan School of Dentistry

Associate Editor, Journal of Dental Education

2 - Dr. Michael Reddy

Dean, University of California, San Francisco, School of Dentistry.

Editor-in-Chief, Journal of Dental Education

Corresponding author:

Dr. Romesh P. Nalliah

Associate Dean for Patient Services, University of Michigan School of Dentistry

1011 N. University

Ann Arbor, MI, 48109

romeshn@umich.edu

734-615-8057

ABSTRACT

Standardized testing has been utilized by K-12 schools, undergraduate and graduate programs as well as employers. Historically, it has been seen as an efficacious way identify the best performing candidates to receive program entry or move forward in a hiring process. However, there is significant evidence mounting about the limitations of standardized testing and, yet, we persist with them because of their relative ease. The purpose of this perspective paper is to begin a conversation about

This is the author manuscript accepted for publication and has undergone full peer review but has not been through the copyediting, typesetting, pagination and proofreading process, which may lead to differences between this version and the [Version of Record](#). Please cite this article as [doi: 10.1002/jdd.12900](https://doi.org/10.1002/jdd.12900).

This article is protected by copyright. All rights reserved.

the place of standardized tests in dental education and it's relationship to institution goals related to diversity, equity and inclusion.

PERSPECTIVE

In 206 BC, the leader of the Han Dynasty in China, Liu Bang¹, had a problem. He wanted to carefully select his leadership team for bureaucratic roles, but, he had hundreds of applicants for just a few positions. The problem was, he had so many people applying that he couldn't get a trusted reference on all of them. Furthermore, they came from such diverse backgrounds with diverse skills that he couldn't be sure of their competence for the specific jobs he was hiring for. Liu Bang, though, had a novel solution for this complex problem – he created the first standardized test. The tests included various skills such as calligraphy, archery, and arithmetic.² Through these standardized test results he selected the best people for his cabinet. Today we are facing a dilemma about using standardized tests in selection processes – evidence shows they are flawed, however, they remain one of the easiest ways to shortlist a huge number of candidates and help determine who will receive an interview. The issue we are addressing in this article is when is standardized testing not standardized and our goal is to ignite discussion on the limitations of standardized tests and the alternate metrics we must consider in truly inclusive admissions processes.

In September 2021, Florida Governor, Ron DeSantis introduced a bill to eliminate the Florida Standards Assessment – a test that determines whether students move up a grade or graduate.³ The University of California decided to eliminate standardized test scores for undergraduate entry with the University's President, Michael Drake, stating that “We don't have an assessment now that we believe we can use effectively.”⁴ However, much of our country still depends on standardized test scores to guide entry into undergraduate, graduate programs and some job opportunities⁵! The intent in standardized testing is to have a very large number of students take the same test - thereby enabling their performances in the test to be compared against each other.⁶ It is believed Liu Bang gave his standardized tests to around one hundred people. Nowadays, standardized tests are given to groups numbering, at least, in the thousands, and sometimes in the millions. This has been an efficient way to

compare a large number of people when more nuanced evaluations are impossible due to the size of the population.

Standardized testing has proven to be neat and efficient for those who administrate over higher education program entry – including dental school admissions. Dental schools may receive far too many applications to review individually and in great detail so the use of academic performance and standardized tests as metrics is commonly employed. Setting a minimum score requirement in a standardized test may enable schools to reduce their eligible pool of candidates to more manageable numbers to examine more holistically.

Today, standardized tests are designed so that the test questions and evaluation processes are consistent. Most tests administered in the K-12 schooling system meet the description of a standardized test – everyone gets the same test, at the same time and under the same circumstances. However, the special term *standardized test* is more commonly used in relation to tests taken by large groups of candidates like the Dental Admissions Test (DAT), the National Board Dental Exams, or the Scholarly Aptitude Test (SAT). Since everyone gets the same questions, standardized tests have been believed to be an equitable manner in which to compare aptitude, knowledge, intelligence and ability. However, we hope to draw your attention to the contrary. We hope to argue, using evidence to support our claims, that there is folly and danger in relying too much on high standardized test scores to select candidates or shortlist candidates.

A study in the US Army in 1917 attempted to measure intelligence using a standardized test.⁷ Here is a quote from the study:

“The group with the highest median scores was native Whites, followed in descending order by immigrant Whites and Native Blacks.”

This study and others like it, were used to justify policies and actions related to racial segregation. However, this study had many shortcomings.

This article is protected by copyright. All rights reserved.

Modern science has demonstrated that race is a social construct rather than a biological difference between human beings.⁸ Today, the validity of using IQ tests as a measure of intelligence has, itself, been disputed.^{9,10} Further, current evidence in genetic medicine indicate no intellectual differences between the races exist and attributes differences like this to environment.¹¹ The mere thought of biologic differences is absurd since 99.9% of the human genome is the same in all of us. Finally, this simplistic army study did not consider important factors like socioeconomic status, education of parents, household income. All of these and many more factors are now well known to affect outcomes in standardized testing.

HOUSEHOLD INCOME

A study entitled “Poverty shrinks brains from birth,” the investigators completed imaging on 1,099 children, adolescent and young adult brains.¹² Researchers adjusted for racial and ethnic differences in body sizes but still found that the brains of kids from households with an average income below \$25,000 were 6% smaller than the brains of kids where average household income was above \$150,000. Certainly, this study cannot prove causality and it cannot exclude the impact of factors like better nutrition may be having. However, these findings are important – other research has shown that the size of a human brain contributes about 9-16% of overall variation in intelligence.¹³ When it comes to brains, size does matter and this difference may be very important. This study also revealed that skills such as decision-making, memory and writing were lower in children who emerged from these lower income households.

In dental schools, we could have one of two reactions to this information. Firstly, we may say that it’s sad that those kids are less intelligent but this makes them less capable to thrive in dental school and they should be excluded. Alternatively, we could respond that some childhood circumstances make it very difficult for children to succeed. Is that reasonable for our society? Shouldn’t we make every effort to insure that children have equal possibilities in life? If you have children or if you’re a proud uncle or aunt, is it acceptable that your special child could be boxed out of certain opportunities just because of where they live or where they went to school or who their parents are. Moreover, evidence

shows that some of students who struggle because of personal situations, socioeconomic barriers, and educational barriers actually become the most caring and empathic individuals¹⁴ – and well suited for a career as a care provider.

Individuals from lower socioeconomic (SE) backgrounds have access to less resources, less certainty in their lives and a reduced sense of personal control. Subsequently, one may anticipate that these individuals would have more selfish behaviors and prioritize themselves over the well-being of others. However, research has demonstrated the very opposite – that those from lower SE backgrounds were more charitable, more generous, more trusting and more socially helpful than those from higher SE groups.¹⁴ Additionally, growing up wealthy is associated with showing less compassion¹⁵ and more unethical behavior.¹⁶ Collectively, these findings may imply that those children from low income households may be exactly the type of person we would want in dental school. However, they are not the ones doing well in standardized testing and progressing through K-12 schools and college.

ACCESS TO HIGH QUALITY TEACHING

Unfortunately, not all teachers are created equal - there are good teachers and there are less good teachers. However, teacher quality has been shown to affect whether or not their students go to college and it even affects the ranking of the college students attend.¹⁷ It is also important to point out that there is evidence that schools paying higher salaries to their teachers attract better quality teachers and, subsequently, the students do better. Research has shown that a 10% increase in teacher pay was estimated to produce at least a 5% increase in student performance.¹⁸ Importantly, this was a not a linear relationship and poorer students actually benefitted more from higher salaried teachers. Higher teacher wages are also linked to their students' completing more years of education and a reduced rate of poverty when they become adults. Collectively, these studies indicate that higher teacher salaries are linked to better learning outcomes in their students. However, evidence shows these connections get even more specific.

Recent research has shown that the variation in teacher salaries is affected by local property tax rates! There's no doubt that property taxes affect the resources of the local government and suburbs with

high housing cost implies that there is a highly resourced local government.¹⁹ Additionally, the tax wealth of a district is a major factor affecting teacher salaries.²⁰ Since property tax is a major component of a district's tax wealth, it follows that districts with highly valued housing are related to higher teacher incomes. This, in turn, is linked to better teacher quality²¹ and better educational outcomes in students. Unfortunately, all of these factors superimpose to create a situation where suburbs with low cost housing, potentially, have the lowest quality and least experienced teachers. Once again, is this an acceptable barrier to impose upon a child? Is it acceptable to make a student take a high-stakes standardized test that affects their future when they have an inequitable playing field?

In the United States we have an ideal that people should work hard and pull themselves up by the bootstraps and create a wonderful life for themselves – the “American dream.” However, we have shared several examples that show that this is simply not possible for children in certain circumstances. We've described some evidence from the K-12 environment, however, we also want to share results of our own studies on national trends in the enrollment of students into dental school by race.

REPOST TABLE 2 FROM OUR PUBLISHED STUDY ON ENROLLMENT.

The table above shows that there has been very little change in the number and percentage of underrepresented minorities enrolling into dental school over the last 20 years. Here in the US, underrepresented minorities disproportionately fill the ranks of low income households.²² We have described how lower income households face barriers in accessing quality education. These inequitable effects in the K-12 system mean that a very unique cohort of students end up going to college – a privileged and less diverse group. Standardized tests are only one of the many barriers students from low income groups and underrepresented minority groups will face in seeking to enter college. Therefore, we also end up with a very unique and privileged group of students going from college to dental school. Unfortunately, many of the standardized tests that a part and parcel of a dental students' journey have been shown to have inherent biases.

American College Testing (ACT)	“Race, class and gender biases give White, affluent, and male test-takers an unfair edge.” ²³
Scholastic Aptitude Test (SAT)	“the SAT, a high-stakes test with significant consequences for the educational opportunities available to young people in the United States, favors one ethnic group over another” ²⁴
Dental Admission Test (DAT)	There is a bias that DAT scores, "when controlled for previous academic performance, revealed that men significantly outperformed women in all areas except reading comprehension and biology.” ²⁵
Graduate Record Examinations (GRE)	GRE itself acknowledges that “members of different racial, ethnic and economic backgrounds perform differently” ²⁶
Advanced Dental Admissions Test (ADAT)	Research has shown that “males performed better than females (p<0.05), and non-Hispanics performed better than Hispanics (p<0.01).” ²⁷

We also know that the traditional National Board Dental Exams were not intended to be used for a variety of purposes other than the purpose for which it was created – to help boards of registration in dentistry in each state to determine a dentists’ qualification for licensure.²⁸ And the jury is still out about the Integrated Board exams. No research has been completed showing bias in this exam which is good news so far. However, it remains pass-fail and is not intended to distinguish between high and low intelligence.

We submit to you that the term “standardized test” is actually an oxymoron in the United States. These tests are not standardized because of all the advantages and disadvantages students have gained for at least two decades before they take the tests that we have interest in. These tests are not a good measure of intellect. They may be a good measure of family wealth, resources, residential ZIP and even privilege. We have also discussed the disturbing evidence that those with wealth and resources may be less ethical, less empathic and less generous. Moreover, we provide a warning that our reliance on standardized tests may actually be excluding the very type of people we want in our programs.

NEUROPLASTICITY OF THE BRAIN

The good news is if you come from a family without high income or access to high quality schools, the process of going to dental school will make you smarter. Since humankind started studying our own brains, we have tried to quantify the capacity of the brain and how intelligent, or smart, someone

is. However, the question is not if you're smarter than someone else, but whether you can be smarter than you are today.

The answer is, you can always make yourself smarter and the best way to do that is education. In fact, some believe there is no limit to how smart you can be and smartness is a process.²⁹

The concept called neuroplasticity has been extensively studied by mapping and administering CT scans on the brains of a people and animals as they learn a skill. Regardless of age brains have the ability to change themselves to fit their owners' needs. The brain can change in response to thoughts and behaviors and is often influenced by environment. Therefore, if you put the person in the right environment (such as being accepted into a dental school) neurons can rewire, become more dense, and—with the right effort and learning strategies—your brain can adapt and change making you smarter. Since Carol Dweck’s seminal work in the field,^{30,31} it is well known that the most important ingredient for learning is not aptitude but attitude – a growth mindset. Perhaps admissions processes should shortlist applicants based on the demonstration of a growth mindset rather than on academic test scores.

Table 2. Enrolled by race (Percent ages)	TOTAL	American Indian or Alaska Native		Asian		Black or African American		Hispanic or Latino	
		Percent age of applica nts enrolle d	Perce ntage of AIAN applica nts enrolle d	Perce ntage of AIAN enrolle es among all enrolle es	Perce ntage of Asian applica nts enrolle d	Perce ntage of Asian enrolle es among all enrolle es	Perce ntage of BAA applica nts enrolle d	Perce ntage of BAA enrolle es among all enrolle es	Perce ntage of HL applica nts enrolle d
2000	X	X	0.50	X	21.87	X	4.70	X	5.36
2001	X	X	0.45	X	21.26	X	5.46	X	5.95

2002	X	X	0.57	X	19.90	X	5.33	X	5.51
2003	X	X	0.51	X	19.92	X	5.81	X	4.95
2004	X	X	0.54	X	18.31	X	5.41	X	5.68
2005	X	X	0.61	X	19.96	X	6.27	X	5.68
2006	X	X	0.76	X	20.23	X	6.11	X	6.21
2007	X	X	0.58	X	20.18	X	5.76	X	6.67
2008	X	X	0.86	X	21.82	X	5.55	X	5.78
2009	X	X	0.49	X	22.71	X	5.17	X	6.53
2010	X	7.21	0.30	2.85	19.73	5.80	5.31	6.28	7.74
2011	X	6.56	0.32	3.40	22.14	5.76	4.86	5.68	7.59
2012	4.64	2.44	0.07	3.14	20.74	7.77	6.88	4.87	6.88
2013	4.82	4.05	0.17	3.66	22.88	6.02	4.65	5.65	8.51
2014	5.13	6.87	0.27	3.92	23.35	6.27	4.34	6.02	8.49
2015	5.21	6.94	0.20	3.94	23.02	6.83	5.12	5.85	9.12
2016	4.99	2.97	0.11	3.92	24.10	5.81	5.05	5.70	9.13
2017	5.11	6.76	0.33	4.06	24.24	5.90	5.10	5.89	9.44
2018	5.61	9.72	0.23	4.64	23.56	6.61	5.34	5.90	10.01
2019	5.92	4.42	0.08	4.84	22.89	7.22	5.78	6.43	10.00

Table 2. Enrolled by race (Percentages)	Native Hawaiian or Other Pacific Islander		White		Two or More Races		Do Not Wish to Report or Unknown		Nonresident Alien	
	Percentage of NHPI applicants enrolled	Percentage of NHPI enrollees among all enrollees	Percentage of White applicants enrolled	Percentage of White enrollees among all enrollees	Percentage of "2 or more races" applicants enrolled	Percentage of "2 or more races" enrollees among all	Percentage of "not wishing to report race / unknown"	Percentage of "not wishing to report race / unknown"	Percentage of "nonresident alien" applicants enrolled	Percentage of "nonresident alien" enrollees among all

		es		es	d	enrolle es	applic ants enrolle d	enrolle es amon g all enrolle es	d	enrolle es
2000	X	X	X	62.47	X	X	X	5.10	X	X
2001	X	X	X	60.23	X	X	X	6.66	X	X
2002	X	X	X	59.06	X	X	X	9.63	X	X
2003	X	X	X	54.86	X	X	X	13.96	X	X
2004	X	X	X	52.82	X	X	X	17.25	X	X
2005	X	X	X	60.73	X	X	X	6.74	X	X
2006	X	X	X	59.35	X	X	X	7.34	X	X
2007	X	X	X	59.81	X	X	X	6.99	X	X
2008	X	X	X	58.11	X	X	X	7.88	X	X
2009	X	X	X	56.37	X	X	X	8.73	X	X
2010	6.82	0.11	5.86	60.87	3.21	2.06	7.11	3.62	X	X
2011	2.75	0.06	5.79	55.17	5.09	2.82	4.16	2.75	3.04	4.29
2012	6.15	0.07	5.37	53.36	4.41	2.79	4.73	3.34	5.99	8.01
2013	4.11	0.05	5.60	53.35	4.67	3.09	4.83	3.14	3.15	4.16
2014	1.94	0.05	5.95	53.73	5.63	2.99	4.59	3.09	3.21	3.68
2015	4.00	0.08	6.07	53.07	5.44	3.11	4.42	2.49	3.39	3.79
2016	7.14	0.16	5.84	51.41	4.67	3.26	5.06	2.66	3.09	4.11
2017	5.56	0.08	5.87	50.36	5.15	3.90	4.96	2.76	3.25	3.79
2018	4.55	0.10	6.29	49.36	5.39	3.34	4.80	4.92	4.39	3.15
2019	4.03	0.08	6.53	49.98	6.28	3.68	5.27	3.07	4.67	4.46

X – denotes that data could no be calculated for that category for that year.

¹ History.com website. Accessed 11/20/21 and available at <https://www.history.com/topics/ancient-china/han-dynasty>

² Zhidong Hao (1 February 2012). *Intellectuals at a Crossroads: The Changing Politics of China's Knowledge Workers*. SUNY Press. pp. 37–. ISBN 978-0-7914-8757-0.

³ Williams O, Ellis R, Kesslen B. National Broadcasting Company News. Published 11/7/21, accessed 10/17/21 and available at <https://www.nbcnews.com/news/us-news/move-end-standardized-testing-high-schools-draws-both-praise-concern-n1282657>

⁴ Zinshteyn M. Times of San Diego newspaper. Published 11/20/21, accessed 12/17/21 and available at <https://timesofsandiego.com/education/2021/11/20/university-of-california-officially-ends-standardized-testing-requirement-for-undergraduates/>

⁵ Bika N. Workable Better Hiring website. Accessed 12/17/21 and available at <https://resources.workable.com/tutorial/pre-employment-tests>

⁶ Poulsen J, Hewson K. Published on University of Lethbridge website. Accessed 10/18/2021 and available at <https://www.ulethbridge.ca/teachingcentre/standardized-testing-fair-or-not>

⁷ Rury, J. L. (1988). Race, region, and education: An analysis of Black and White scores on the 1917 Army Alpha Intelligence Test. *Journal of Negro Education*, 57(1), 51–65. <https://doi.org/10.2307/2295276>

⁸ Morning, Ann. “‘Everyone Knows It’s a Social Construct’: Contemporary Science and the Nature of Race.” *Sociological Focus*, vol. 40, no. 4, Taylor & Francis, Ltd., 2007, pp. 436–54, <http://www.jstor.org/stable/20832348>.

⁹ Yale University website. Accessed 10/18/21 and available at <https://som.yale.edu/news/2009/11/why-high-iq-doesnt-mean-youre-smart>

¹⁰ Martschenko D. The IQ test wars: why screening for intelligence is still so controversial. The Conversation news website (10/10/17). Accessed 10/18/21 and available at <https://theconversation.com/the-iq-test-wars-why-screening-for-intelligence-is-still-so-controversial-81428>

¹¹ Tishkoff SA, Kidd KK. Implications of biogeography of human populations for 'race' and medicine. *Nat Genet*. 2004 Nov;36(11 Suppl):S21-7. doi: 10.1038/ng1438. PMID: 15507999.

¹² Reardon, S. Poverty shrinks brains from birth . *Nature* (2015). <https://doi.org/10.1038/nature.2015.17227>

-
- ¹³ Koch C. Does brain size matter? Published 1/1/2016 on The Scientific American website. Accessed 10/22/21 and available at <https://www.scientificamerican.com/article/does-brain-size-matter1/>
- ¹⁴ Piff PK, Kraus MW, Côté S, Cheng BH, Keltner D. Having less, giving more: the influence of social class on prosocial behavior. *J Pers Soc Psychol.* 2010 Nov;99(5):771-84. doi: 10.1037/a0020092. PMID: 20649364.
- ¹⁵ Stellar JE, Manzo VM, Kraus MW, Keltner D. Class and compassion: socioeconomic factors predict responses to suffering. *Emotion.* 2012 Jun;12(3):449-59. doi: 10.1037/a0026508. Epub 2011 Dec 12. PMID: 22148992.
- ¹⁶ Piff PK, Stancato DM, Côté S, Mendoza-Denton R, Keltner D. Higher social class predicts increased unethical behavior. *Proc Natl Acad Sci U S A.* 2012 Mar 13;109(11):4086-91. doi: 10.1073/pnas.1118373109. Epub 2012 Feb 27. Erratum in: *Proc Natl Acad Sci U S A.* 2017 Oct 24;114(43):E9181. PMID: 22371585; PMCID: PMC3306667.
- ¹⁷ Chetty, Raj, John N. Friedman, and Jonah E. Rockoff. "The Long-Term Impacts of Teachers: Teacher Value-Added and Student Outcomes in Adulthood." National Bureau of Economic Research Working Paper 17699 (2011). NBER.ORG. Web. 30 Sept. 2015.
- ¹⁸ C. Kirabo Jackson, Rucker C. Johnson, Claudia Persico, The Effects of School Spending on Educational and Economic Outcomes: Evidence from School Finance Reforms , *The Quarterly Journal of Economics*, Volume 131, Issue 1, February 2016, Pages 157–218, <https://doi.org/10.1093/qje/qjv036>
- ¹⁹ Van Nortwick P. Published on The Reflector newspaper website on 9/17/18. Accessed 10/24/21 and available at <https://www.thereflector.com/stories/teacher-salaries-and-property-taxes,37229>
- ²⁰ Winters, John V. "Variation in teacher salaries in Georgia: does the property tax base matter?" *Journal of Education Finance*, vol. 35, no. 2, fall 2009, pp. 157+. *Gale General OneFile*, link.gale.com/apps/doc/A211232421/ITOF?u=umuser&sid=bookmark-ITOF&xid=4f85f719. Accessed 7 Sept. 2021.
- ²¹ Hansen ML, Lien DS, Cavalluzzo LC, Wegner JW. Relative pay and teacher retention: An empirical analysis in a large urban district. Published by Center for Naval Analyses (CNA) in Mar 2004. Accessed 10/28/21 and available at <https://files.eric.ed.gov/fulltext/ED485516.pdf>
- ²² Stewart III S. Chui M, Manyika J, Julien JP, Hunt V, Sternfels R, Woetzel J, Zhang H. The economic state of Black America. Published by McKinsey and Company. Accessed 10/26/21 and available at <https://www.mckinsey.com/featured-insights/diversity-and-inclusion/the-economic-state-of-black-america-what-is-and-what-could-be>
- ²³ National Center for fair and open testing. "The ACT: Biased, inaccurate and misused." Published 8/20/2007. Accessed 10/18/21 and available at <https://fairest.org/act-biased-inaccurate-and-misused>

²⁴ Jaschik S. New evidence of racial bias on SAT. Published on Inside Higher Education website on 6/21/10. Accessed 11/14/21 and available at <https://www.insidehighered.com/news/2010/06/21/new-evidence-racial-bias-sat>

²⁵ Fields HW, Fields AM, Beck FM. The impact of gender on high-stakes dental evaluations. *J Dent Educ.* 2003 Jun;67(6):654-60. PMID: 12856965.

²⁶ Educational Testing Services. "Test takers from underrepresented groups." Published on the ETC website. Accessed 11/22/21 and available at https://www.ets.org/gre/institutions/admissions/using_scores/underrepresented/

²⁷ DeSantis LL, Ghoneima A, John V, Eckert G, Stewart KT. Preliminary Performance of the Advanced Dental Admission Test (ADAT): Association Between ADAT Scores and Other Variables for Applicants to Residency Programs at a U.S. Dental School. *J Dent Educ.* 2018 Dec;82(12):1327-1334. doi: 10.21815/JDE.018.137. PMID: 30504471.

²⁸ Neumann LM, Macneil RL. Revisiting the National Board Dental Examination. *J Dent Educ.* 2007 Oct;71(10):1281-92. PMID: 17923706.

²⁹ Optimizing brain performance: Identifying mechanisms of adaptive neurobiological plasticity. *Neurosci Biobehav Rev.* 2019 10; 105:60-71. Lambert K, Eisch AJ, Galea LAM, Kempermann G, **Merzenich M.** PMID: 31356835.

³⁰ Paunesku D, Walton GM, Romero C, Smith EN, Yeager DS, Dweck CS. Mind-set interventions are a scalable treatment for academic underachievement. *Psychol Sci.* 2015 Jun;26(6):784-93. doi: 10.1177/0956797615571017. Epub 2015 Apr 10. PMID: 25862544.

³¹ Rattan A, Savani K, Chugh D, Dweck CS. Leveraging Mindsets to Promote Academic Achievement: Policy Recommendations. *Perspect Psychol Sci.* 2015 Nov;10(6):721-6. doi: 10.1177/1745691615599383. PMID: 26581725.